DoD High Level Architecture (HLA) for Simulation – Policy and Process –

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HLA: DoD Technical Architecture for Simulation

- **DoD Policy**

  "Under the authority of [DoD Directive 5000.59], and as prescribed by [the DoD Modeling and Simulation Master Plan], I designate the High Level Architecture as the standard technical architecture for all DoD simulations."

  Dr. Paul Kaminski
  10 September 1996

- **Based on**
  - **Unanimous EXCIMS approval on 5 September 1996**
  - **Unanimous AMG endorsement on 21 August 1996**

HLA: DoD Technical Architecture for Simulation

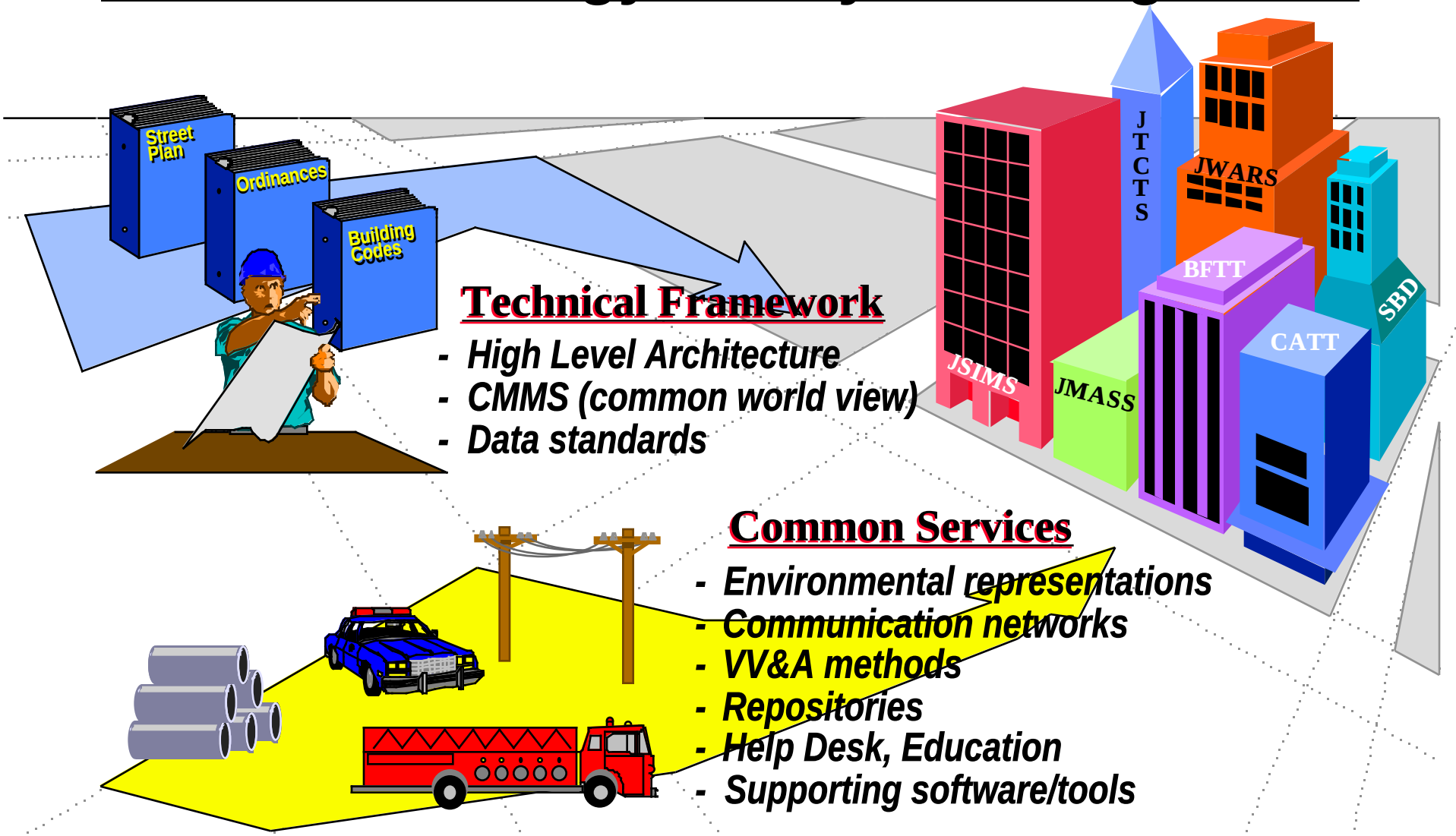
- **Baseline Definition**

  "The baseline HLA is defined by three inter-related elements: HLA Rules Version 1.0 (v.1.0), HLA Interface Specification v.1.0, and HLA Object Model Template v.1.0."

- **Critical Dates**

  "DoD Components shall review all of their simulation projects and programs by the second quarter fiscal year (FY) 1997 in order to establish plans for near-term compliance with the HLA. The Department shall cease further development or modification of all simulations which have not achieved, or are not in the process of achieving, HLA-compliance by the first day of FY 1999, and shall retire any non-compliant simulations by the first day of FY 2001."

DoD M&S Strategy: An Analogy to City Planning



Technical Framework

- *High Level Architecture*
- *CMMS (common world view)*
- *Data standards*

Common Services

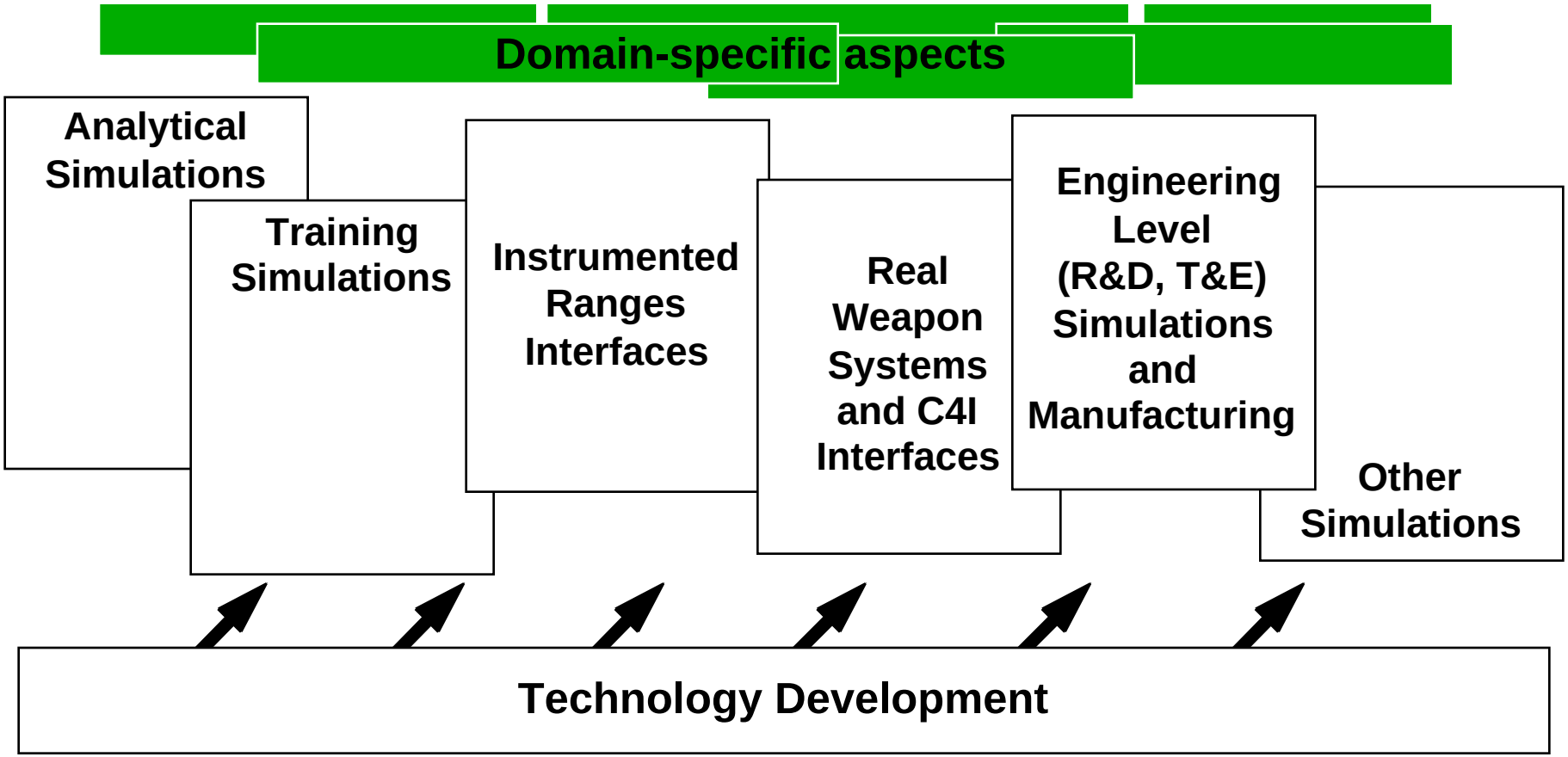
- *Environmental representations*
- *Communication networks*
- *VV&A methods*
- *Repositories*
- *Help Desk, Education*
- *Supporting software/tools*

Payoffs: Interoperability and reuse = capability and cost-effectiveness

DoD M&S Master Plan Objective 1

A Common Technical Framework for M&S

High Level Architecture, Conceptual Models of the Mission Space, Data Standards



HLA Required by DoD M&S Master Plan

Objective 1

Develop a common technical framework for M&S

Sub-objectives

1-1 High-level Architecture (HLA)

Establish a common high-level simulation architecture to facilitate the interoperability of all types of models and simulations among themselves and with C4I systems, as well as to facilitate the reuse of M&S components

1-2 Conceptual models of the mission space (CMMS)

1-3 Data standards

Scope of HLA

- **Applicable to broad range of functional areas (e.g., training, contingency planning, analysis, and acquisition)**
- **Applicable to simulations involving pure software representations, man-in-the-loop simulators, and live components (instrumented-weapon and C3 systems)**

Rationale for HLA Design

- **Basic premises:**
  - **No single, monolithic simulation can satisfy the needs of all users**
  - **All uses of simulations and useful ways of combining them cannot be anticipated in advance**
  - **Future technological capabilities must be accommodated**
- ***Consequence:*** **Need composable approach to constructing simulation applications**
- ***Resulting design principles:***
  - **Simulation applications constructed from modular components with well-defined functionality and interfaces**
  - **Specific simulation functionality separated from general purpose supporting runtime infrastructure**

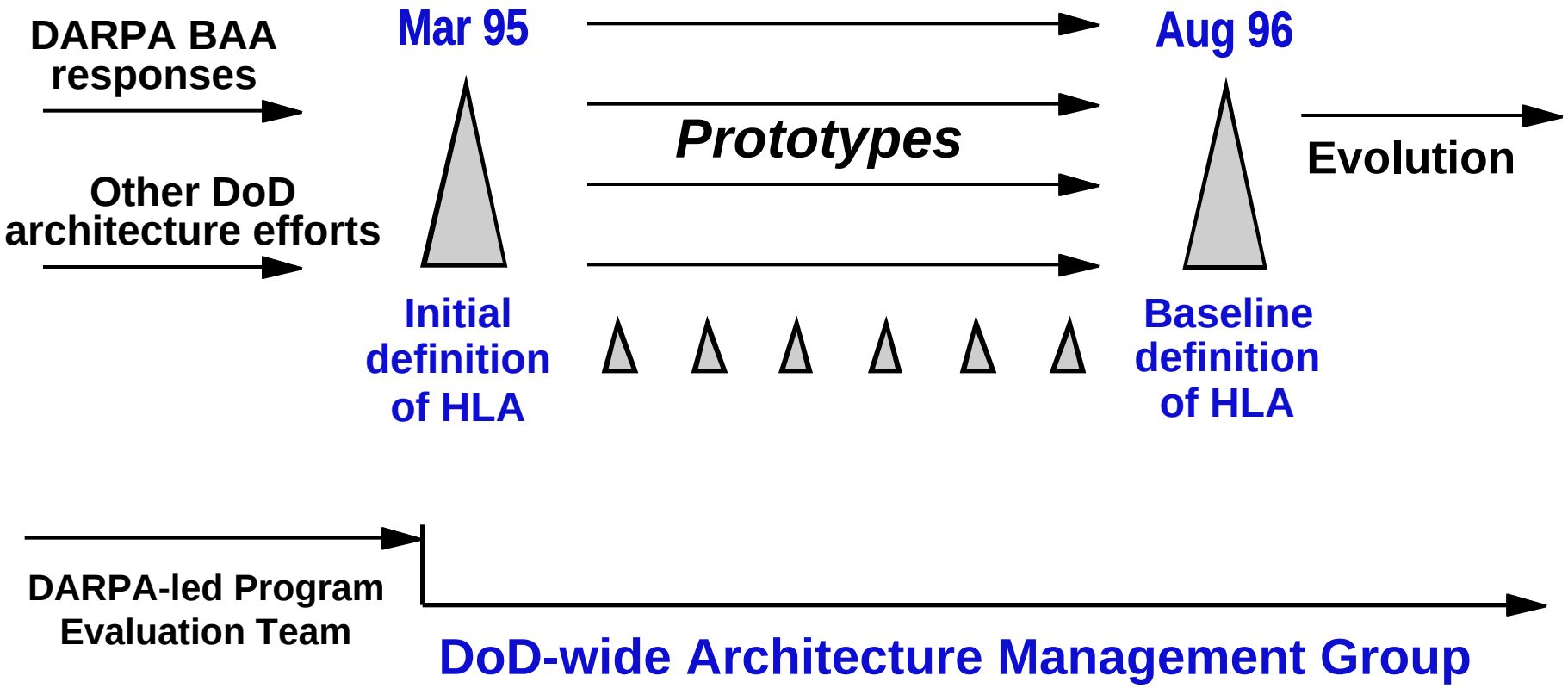
Interoperability

- **HLA is a critical enabler for establishing interoperability among simulations of a federation**
  - **Interface definitions allow exchange of data; object models and time management constraints facilitate consistent interpretation of data**
  - **Interoperability is a matter of degree; it could require federation-specific constraints beyond those imposed by HLA**
  - **A disciplined, common-sense approach to the development of simulations and federations is still required**

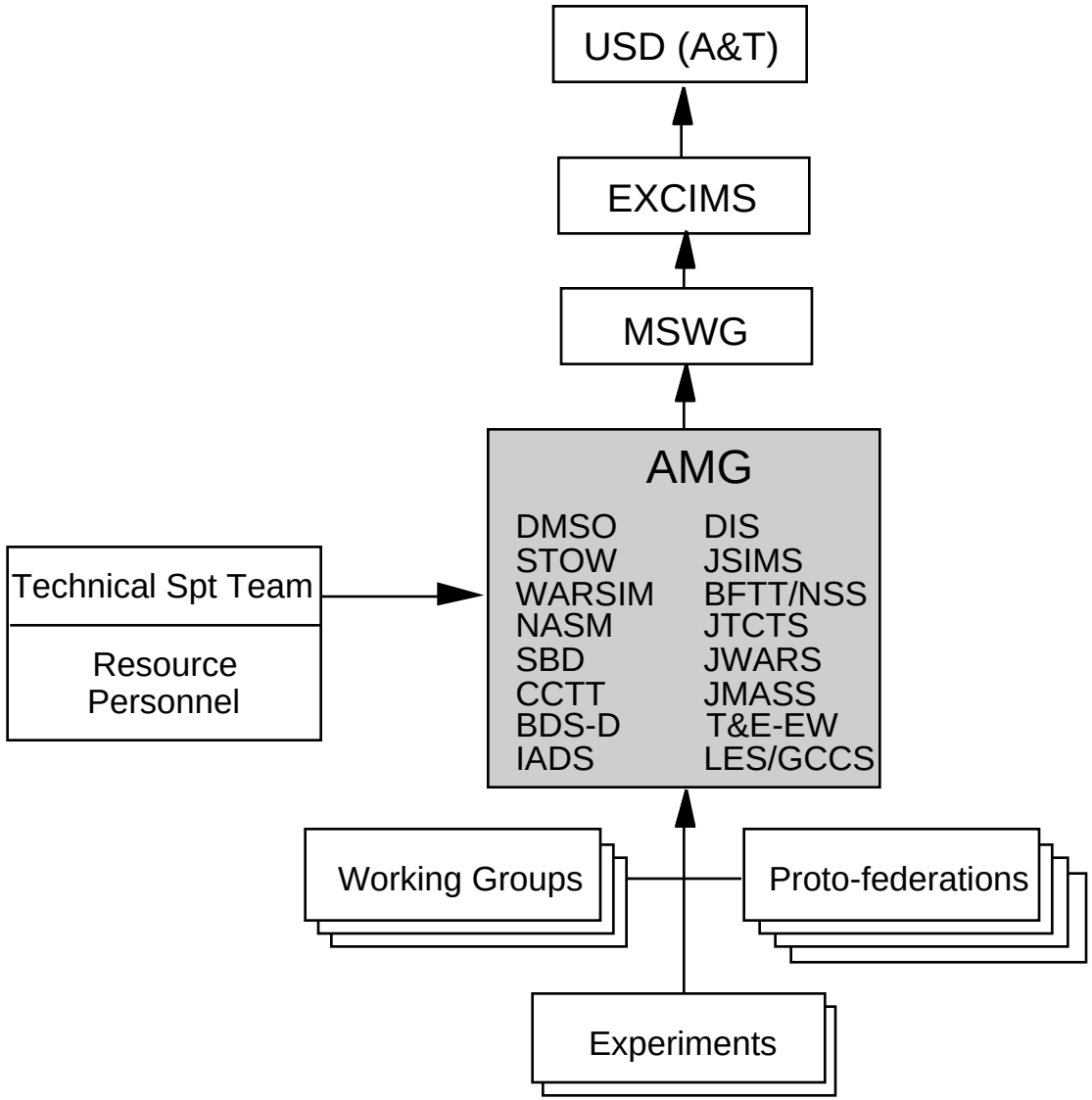
Reuse

- **HLA facilitates reuse of simulation components – for both object representations and infrastructure functionality**
  - **Interface definitions and standard structure for object models allow for reuse of individual simulations and federations, as well as infrastructure**
- **The HLA alone cannot guarantee cost-effectiveness or a meaningful, coherent synthetic environment which satisfies a particular user's purpose, but it provides a solid foundation for these tasks**

HLA Development Process Overview



Architecture Management Group Structure



AMG Membership

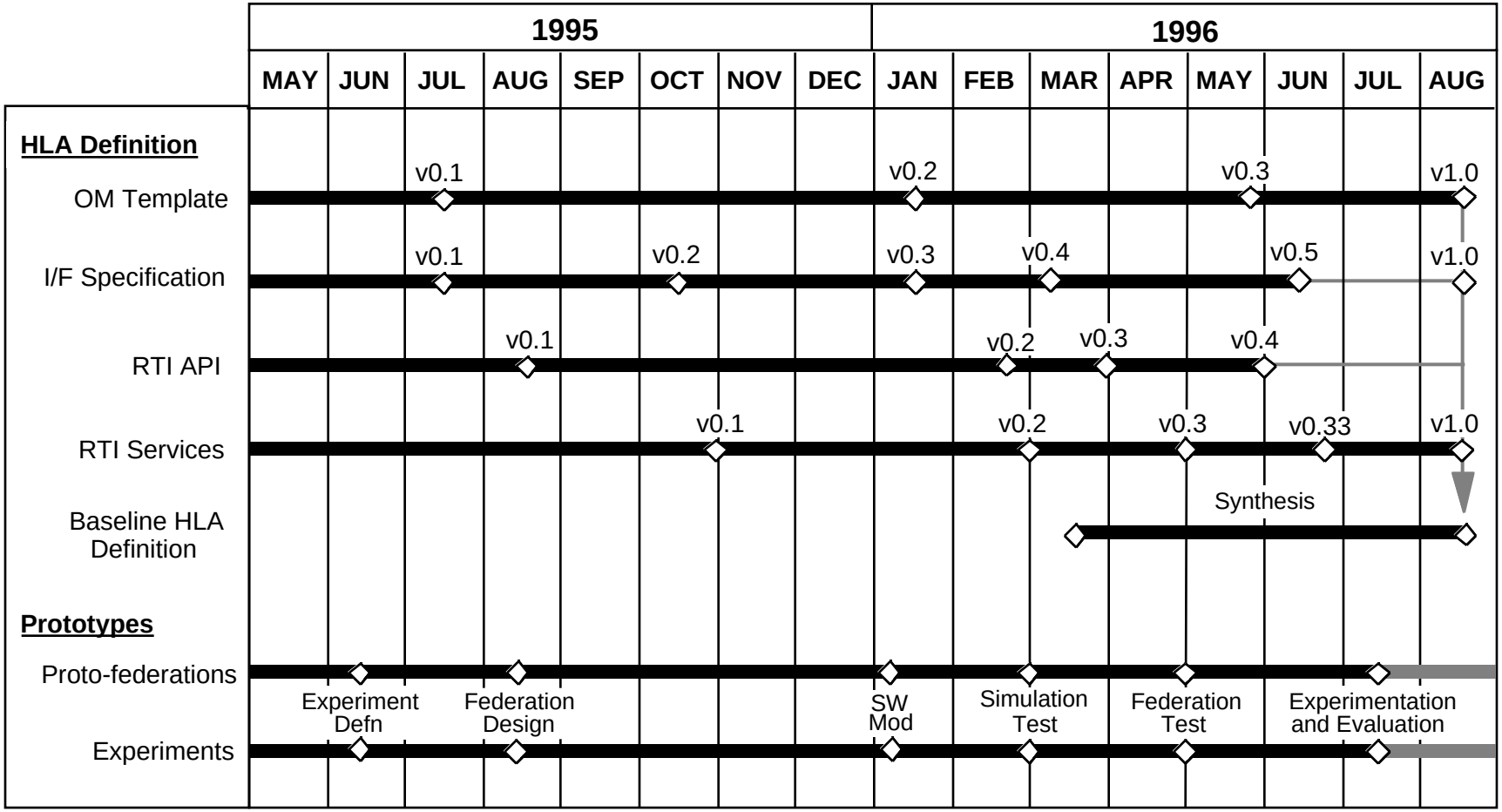
Members	Representing
CAPT Jim Hollenbach	DMSO
CAPT Drew Beasley	JSIMS
LTC Terry Prosser	JWARS
Mr. Dell Lunceford	STOW/ADS
Ms. Annette Ratzenberger	WARSIM 2000
Dr. Les Parish	BFTT/NSS
Mr. Tim Rudolph	NASM
Mr. Al Gramp	JTCTS
Mr. Gary Jones	Sim Based Design
COL James Shiflett	CATT
Dr. Duncan Miller	DIS Stds Cmte
LtCol Mike Cappelano	JMASS
Mr. Rich Pace	DTSEE(T&E EW)
Mr. Francis Cline	DIA/MSIC (IADS)
MAJ Jim Knowles	DISA/LES GCCS
COL Jim Etchechury	BDS-D

Industry Participation in HLA Definition

Under the AMG, approximately 240 persons substantively participated in the definition of the HLA. The breakdown:

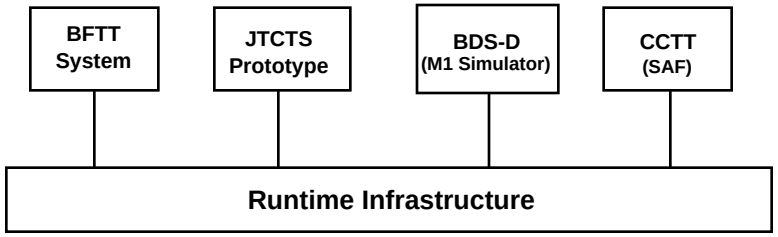
- **85 Government (35%)**
- **28 FFRDC (12%)**
- **13 Academia (5%)**
- **114 Industry (48%)**

Master Schedule

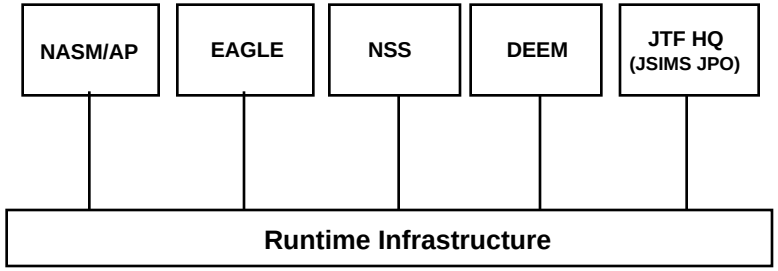


HLA Prototype Federations

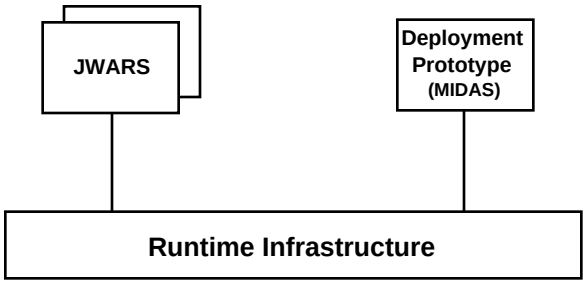
Platform Federation



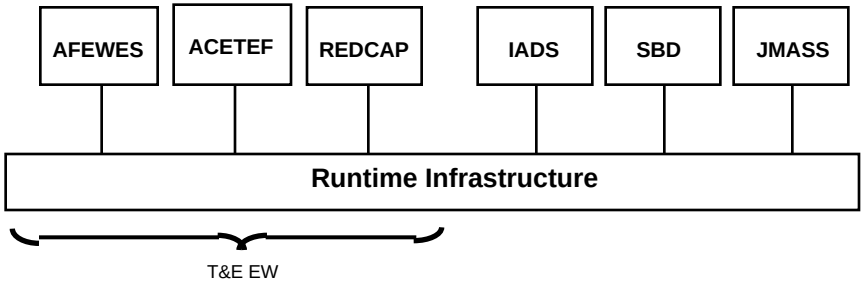
Joint Training Federation



Analysis Federation



Engineering Federation



AMG Prototype Implementations Using the HLA

- **25+ simulations**

  BFTT, JTCTS (simulation only), BDS-D (M1 simulator), CCTT SAF, Eagle (adapted to work with several federations), DEEM, MIDAS, AFEWES, SWEG, F-18 simulator, ATEWES, REDCAP, IADS, *J-MASS (several sims), *Simulation Based Design (several sims), ModSAF, Strike, ASAS RCW, ADOCS, SIU, *NSS, *NASM/AP, *JWARS (two versions), *JTF HQ

  **** indicates new build for HLA prototyping; there are also support tools (new and adapted) not included here***

- **one Runtime Infrastructure (RTI) prototype implementation**
- **training, analysis, and acquisition support applications**
- **unit, platform, and weapon system component level granularity**

continued

AMG Prototype Implementations Using the HLA

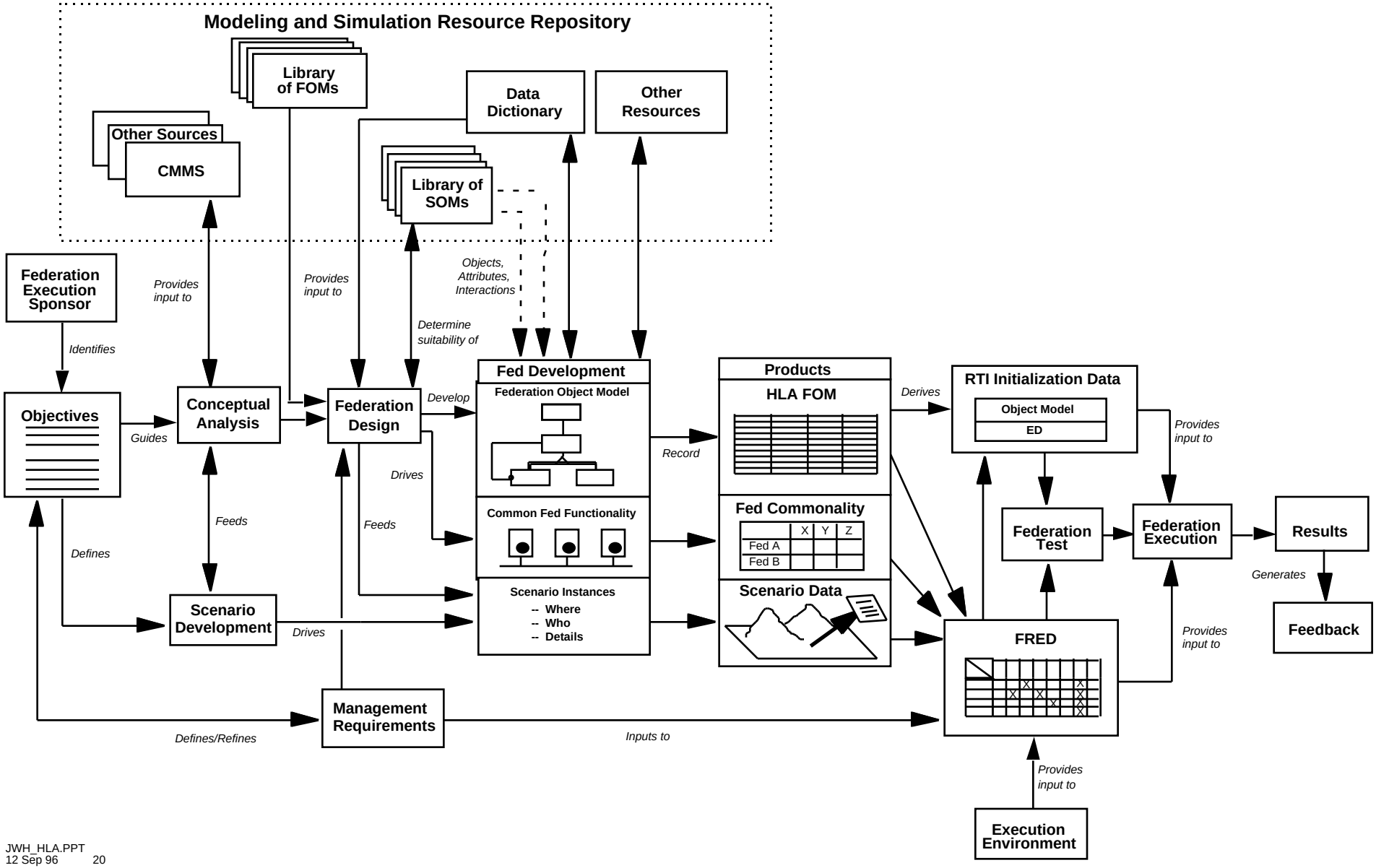
continued

- **human-in-the-loop, hardware-in-the-loop, and closed-form simulations**
- **real-time and fast-as-possible discrete event simulations**
- **classified and unclassified federations**
- **local and wide area networks (e.g., DSI, landlines) across the USA**
- **running on Sun, Silicon Graphics, HP, and IBM workstations**
- **developed since summer 95 and operating since March 96 to address issues identified by each protofederation and the AMG**

HLA Baseline

- **HLA baseline is defined by versions 1.0 of HLA Rules, Interface Specification, and Object Model Template**
- **Result of**
  - **9 month DARPA BAA/PET process and**
  - **17 month AMG review and prototyping process**
- **Produced a baseline architectural definition which is much better than a typical paper review product. Will be refined, evolved.**
  - **some additional technical investigations already planned**
- **Evolution will be managed via the ongoing AMG process with expanded participation from programs transitioning to HLA and external professional and standards organizations**
- **AMG has planned a two-year transition period to evolve the architecture, with periodic review/revision cycles**

Federation Development and Execution Process



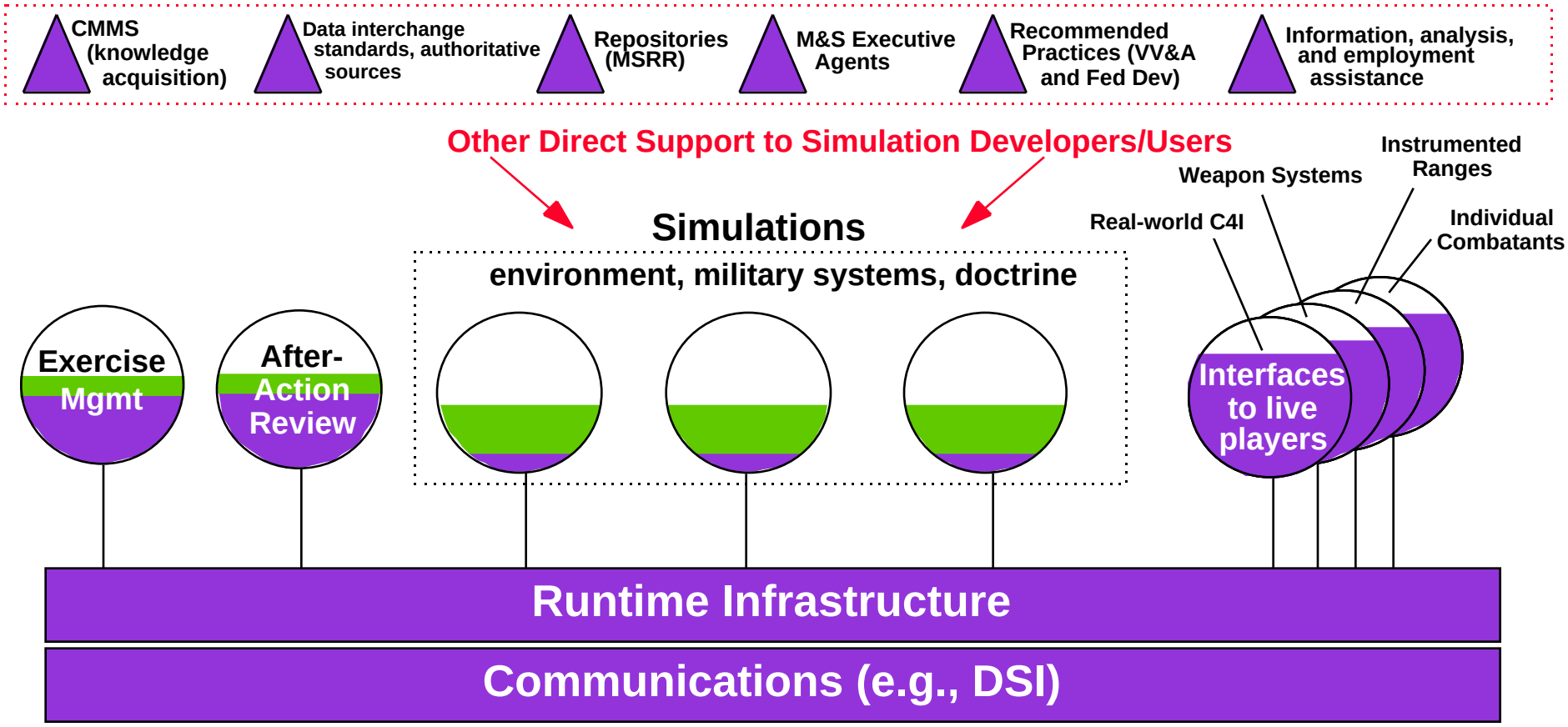
Security

- Security has been considered by AMG since the beginning
  - contractor support and proto-federation experience
- AMG adopted a three-phase strategy:
  - near-term: system high
  - mid-term: guarded system
  - long-term: true multi-level security (MLS)
- True MLS remains out of reach for the foreseeable future for anything, including simulations
- Mid-term security architecture has been developed
- Discussions with NSA ongoing with a view towards providing policy guidance to M&S community and identifying/developing appropriate one-way and two-way guards

Runtime Infrastructure (RTI) Development

- Versions used in prototyping being retired
- 1.0 version of DoD RTI shareware
  - F.0 familiarization version available in December 1996
    - C++ API
    - Sun platform/OS
    - online ordering via the DMSO web page
  - Follow-up 1.0 version available late Spring 1997, w/ increased performance
- Parallel effort with industry to develop 2.0 version(s)
  - BAA 26 August 1996, two-phase (design/develop) strategy
  - Available for distribution in Spring/Summer 1998
- RTI user support (documentation, training, technical hotline) for these RTI software versions

Fostering Cost Effectiveness through Reuse

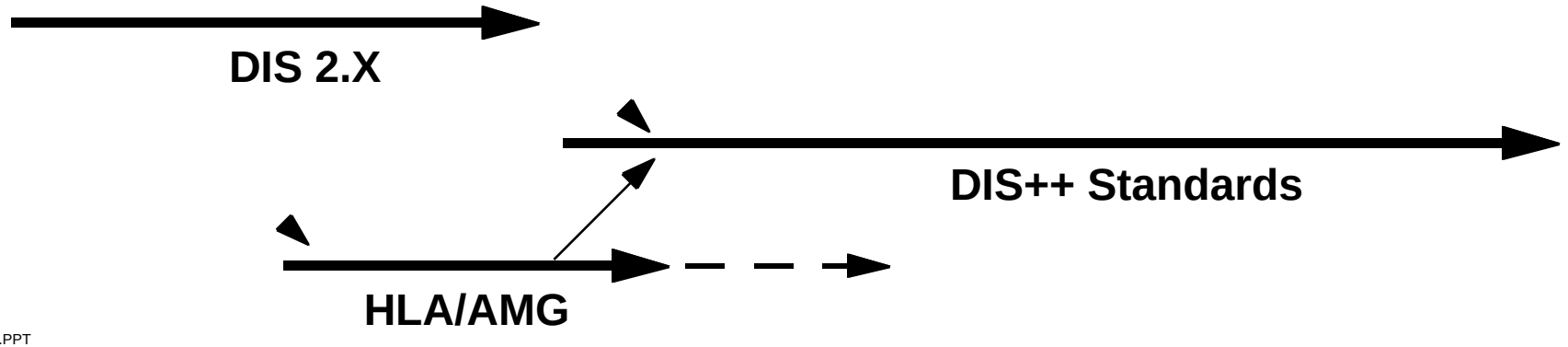


Key:

- Reusable across all DoD simulation systems
- Reusable across a simulation domain
- unique

HLA Supporting Standards

- **Important that HLA be integrated into broader, industry based technical community**
  - **Many HLA concepts/goals were birthed within DIS workshop**
  - **HLA development supports achievement of the DIS Vision**
  - **DIS players are deeply involved in HLA development**
  - **DIS Workshop is the desired venue for establishment of HLA supporting standards.**



HLA Technical Library

- **DMSO has established an online "public library" for the M&S community**
- **Contents**
  - **HLA Baseline Definition (Rules, Interface Specification, Object Model Template)**
  - **HLA Glossary**
  - **Interface Specification Supporting Documents (Test Procedures, Time Management, API)**
  - **OMT Supporting Documents (OMT Extensions, Test Procedures)**
  - **HLA Compliance Checklist**
  - **HLA Federation Development Process Model**
  - **HLA Security Architecture**
  - **Additional briefings and documents**

On-Line Documentation

- **Defining documents and supporting technical information appear under the subtopic "Common Technical Framework for M&S", under "High Level Architecture". DMSO home page site is:**

  http://www.dmso.mil/

- **Users are able to submit questions and problems directly to DMSO via e-mail**

  hla@msis.dmso.mil